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Genetics, Growth and Yield, Timber Quality And Pest Hardiness of Forests in the Peace Region of Alberta
1999 – Update

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Applied Forest Genetics Research and Practical Tree Breeding To Enhance Growth, Yield, Timber Quality and Pest Hardiness Of Future Forests In The Peace Region

Project Progress Report 1998/99
Submitted To
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TABLE OF CONTENTS

1. Introduction 1
2. Parent Tree Selections, Basses Population Development and Project Documentation ... 1
3. Region "G2" Seed Orchards 2
4. Alberta White Spruce Provenance Trial Assessment and Analysis 2
5. Range Wide White Spruce Provenance Trial 6
6. Manning Area woodlot Research and Demonstration Project 6
7. Progeny Test Site Development and Chinchaga Test Site Maintenance 6
8. Publications 7
9. 1998/99 Expenditures 7
10. Acknowledgment 7

1. Introduction

The present report covers the fourth year of progress for the genetics and tree improvement research and development project in the Manning-Peace River area of the northwest boreal region. During the year Canadian Forest Products Ltd. (Canfor) decided to discontinue its participation in the "G2" project due to financial constraints. Canfor's share of project and work responsibilities were divided among Manning Diversified Forest Products Ltd and Alberta Land and Forest Service (LFS)..

The current work program developed and carried out with MDFP Research Trust Fund funding consisted of: carrying out technical reviews and provision of professional support to industry and LFS partners in selection and development of a suitable base population for white spruce and lodgepole pine breeding; professional support for regional progeny test site selection and development; coordination of seed orchard development planning and assistance in experimental design and layout; field measurements and statistical analyses for provenance and progeny research trials located at the Chinchaga experimental site; ongoing cooperation in the exchange of scientific information and genetic stock with the B.C. Ministry of Forests (M.O.F.) beneficial to the 'G2' project; continuation of participation in the regional woodlot project. A brief report on the project activities carried out during the year is provided below.

2. Parent Tree Selections, Base Population Development and Project Documentation

All superior parent tree selections for both the white spruce and modified pine projects are completed. The last set of field collections, documentation and parent tree report for the 21 new pine selections for the Peace region were finalized in 1998 (File report ATISC-98-06).

Parent trees documentation and reports for both the white spruce and pine projects were consolidated with the exception of the report for the 40 lodgepole pine genetic lines acquired from the B.C. Ministry of Forests which is currently being finalized.

The 1998 white spruce cone crop was monitored and collection of cones from 7 additional trees was made by MDFP with assistance from the project staff. Cone crop collections on southern "G2" trees were unfortunately missed as Canfor did not action on these due to their forthcoming

decision to withdraw from the project. Seed extraction for the spruce as well as the final pine selections is completed, seedlots germination tested and archived at Tree Improvement and Seed Centre.

Scion and seed collections from promising "G2" and adjoining regions collections were provided to B.C. Ministry of Forests, Kalamalka Forestry Centre for establishment in their Hudson Hope - Fort St. John seed orchard and progeny trials.

3. Region "G2" Seed Orchards

Stock was grown and provided to re-establish the shelterbelt along the west and north sides of the orchards site at the Fairview College. In August, the survival of stock in the shelterbelts was reviewed and estimated to be greater than 95%.

Due to Canfor's withdrawal from the white spruce project, most of the site development items at the College were delayed until 1999. A meeting of project partners were held at Fairview College Campus in Peace River in October 1998. New project partnership arrangements were discussed. The project share and outstanding financial responsibilities of Canfor were divided 50:50 between MDFP and LFS. Project concept is being modified to scale back some work without affecting scientific soundness of the project. Efforts will be continued to seek additional industry participation in the project.

Statistical and genetic designs for orchard layout were completed for both the spruce and pine projects. Graft allocation for 1999 planting of both orchards will be made based upon confirmation of stock inventories in spring.

4. Alberta White Spruce Provenance Trial Assessment and Analysis

21-year-assessments were completed on the Chinchaga site white spruce provenance trial (G103G) which contains 28 provenances (Table 1) collected throughout Alberta. Traits measured were survival, height, vigour, stem straightness, Dbh, white pine weevil and climatic damage. Data were keypunched, verified and merged with the prior 12, 15 and 18- year assessments data of the same trial. Statistical analysis of the data and evaluation of the results was completed.

Results (Tables 2 and 3) showed significant provenance differences in height growth for all assessment years. Significant differences were also found for Dbh, with the range of provenance means being 3.7cm to 7.9 cm for 21- yr data. Plantation mean survival was 84.9 % which was a 2.6 % decrease from survival at 18-yr age although differences among provenance means were not significant. White pine weevil damage was low and had increased by about 3.3% over the past 3 years.

Provenance means for total height, diameter at breast height, vigor, stem quality and weevil damage were significantly correlated (Table 4) with latitude and elevation. Local provenances appeared to be more optimal in growth. Detailed analysis of the research trial data has been completed and these will be combined with results of another trial (G103B) established near High Level to develop a synthesis of provenance variation and performance results in northwestern Alberta.

Table 1. Seed-lot origins for G103G white spruce provenance trial at Chinchaga Genetics Site (G103G, 57°50'N, 118°12'W, 470m).

Acc.	Locaion	Eco-region	Latitude (°N)	Longitude (°W)	Elevation (m)
2	Footner Lake	Boreal Wetland Mixwood	58°44'	117°15'	335
4	4 Footner Lake	Boreal Central Mixwood	57°55'	115°30'	360
6	Athabasca	Boreal Peace River Lowland	58°44'	111°15'	235
8	Athabasca	Boreal Central Mixwood	57°08'	111°38'	274
10	Athabasca	Boreal Peace River Lowland	59°53'	111°43'	183
12	Lac La Biche	Boreal Central Mixwood	54°38'	110°13'	610
15	Slave Lake	Boreal Central Mixwood	56°38'	114°35'	731
16	16 Slave Lake	Boreal Central Mixwood	54°48'	116°59'	731
17	Slave Lake	Boreal Central Mixwood	55°14'	114°46'	610
19	Slave Lake	Boreal Dry Mixwood	55°29'	116°05'	610
20	Slave Lake	Boreal Central Mixwood	55°46'	113°18'	579
21	Peace River	Boreal Dry Mixwood	57°36'	117°31'	460
22	Peace River	Foothills (Lower)	56°59'	117°50'	610
23	Peace River	Foothills (Upper)	56°34'	119°40'	762
24	Peace River	Foothills (Lower)	56°28'	118°05'	823
26	Grande Prairie	Boreal Dry Mixwood	55°35'	119°35'	838
27	Grande Prairie	Boreal Dry Mixwood	55°35'	118°18'	640
29	Grande Prairie	Foothills (Lower)	54°27'	118°38'	940
31	Edson	Foothills (Upper)	53°46'	118°48'	1402
32	Edson	Foothills (Upper)	53°14'	117°28'	1340
37	Whitecourt	Foothills (Lower)	54°11'	116°37'	945
40	Rocky/Clearwater	Foothills (Upper)	52°10'	115°28'	1341
46	Bow/Crow	Subalpine (Rocky Mtn.)	51°24'	115°13'	1750
48	Bow/Crow	Subalpine (Rocky Mtn.)	49°39'	114°37'	1585
446	Cypress Hills	Montane	49°38'	110°14'	1310
782	Edson	Subalpine (Rocky Mtn.)	53°03'	117°28'	1707
783	Bow/Crow	Subalpine (Rocky Mtn.)	50°47'	115°20'	1859
784	Footner Lake	Boreal Wetland Mixwood	59°32'	117°13'	305

Table 2. Mean growth performance of 28 white spruce provenances at Chinchaga Genetics Site (G103G)†

Acc.	Locaion	HT12	HT15 (m)	HT18 (m)	HT21 (m)	MAI (m)	DBH18 (cm/yr)	DBH21 (cm)	(cm)
21	Peace River		2.16	3.37	4.00	5.61	38.20	5.81	7.83
24	Peace River		2.04	3.22	3.91	5.57	39.28	5.73	7.78
4	Footner Lake		2.05	3.19	3.87	5.53	38.63	5.70	7.87
16	Slave Lake		2.10	3.29	3.88	5.46	37.26	5.76	7.87
27	Grande Prairie		2.01	3.20	3.81	5.45	37.75	5.61	7.75
15	Slave Lake		2.10	3.24	3.90	5.45	37.17	5.63	7.49
29	Grande Prairie		1.99	3.09	3.69	5.41	37.68	5.63	7.63
12	Lac La Biche		1.98	3.05	3.77	5.38	36.98	5.77	7.84
2	Footner Lake		1.88	2.91	3.60	5.22	37.03	5.55	7.62
17	Slave Lake		1.94	3.12	3.74	5.17	35.84	5.42	7.34
22	Peace River		1.86	2.94	3.58	5.11	36.11	5.29	7.38
8	Athabasca		1.90	2.92	3.54	5.10	35.27	5.47	7.45
23	Peace River		1.86	2.97	3.57	5.09	35.89	5.42	7.33
20	Slave Lake		1.89	3.01	3.55	5.09	35.18	5.23	7.22
19	Slave Lake		1.85	2.93	3.49	5.03	34.98	5.04	7.03
46	Bow/Crow		1.92	2.87	3.52	5.01	34.31	5.43	7.41
32	Edson		1.85	2.96	3.59	5.00	35.04	5.46	7.32
446	Cypress Hills		2.05	3.16	3.76	4.96	32.37	6.17	7.96
26	Grande Prairie		1.78	2.77	3.33	4.89	34.23	4.78	6.70
37	Whitecourt		1.86	2.95	3.48	4.88	33.59	5.28	7.24
6	Athabasca		1.76	2.67	3.27	4.83	34.01	4.79	6.64
784	Footner Lake		1.81	2.70	3.32	4.82	33.47	4.89	6.85
40	Rocky/Clearwater		1.87	2.88	3.45	4.80	32.37	5.30	6.98
10	Athabasca		1.71	2.53	3.15	4.58	31.90	4.72	6.40
31	Edson		1.69	2.71	3.25	4.58	31.97	5.09	6.96
48	Bow/Crow		1.35	2.17	2.56	3.71	25.56	4.48	5.54
782	Edson		1.04	1.67	1.94	2.72	18.45	2.98	3.84
783	Bow/Crow		1.07	1.69	1.94	2.67	17.37	3.37	3.63
	Overall mean		1.84	2.87	3.45	4.91	33.97	5.25	7.09
	Standard error		0.01	0.02	0.03	0.04	0.28	0.05	0.06

† Provenances sorted according to their 21-yr height performance; The abbreviations of traits measured are listed below:

HT12 - height at age 12; HT15 - height at age 15; HT18 - height at age 18;
HT21 - height at age 21; MAI - Mean annual increment between ages 12 and 21;
DBH18 - Diameter at breast height at age 18;
DBH18 - Diameter at breast height at age 21

Table 3. Mean survival performance of 28 white spruce provenances at Chinchaga Genetics Site (G103G)†

Acc.	Locaion	S12	S15 (%)	S18 (%)	S21 (%)	MDS (%)	(%)
21	Peace River		86.67	86.67	86.67	84.44	0.25
24	Peace River		91.11	91.11	91.11	91.11	0.00
4	Footner Lake		86.67	86.67	86.67	84.44	0.25
16	Slave Lake		88.89	88.89	88.89	88.89	0.00
27	Grande Prairie		93.33	93.33	93.33	88.89	0.49
15	Slave Lake		86.67	86.67	91.11	84.44	0.25
29	Grande Prairie		84.44	84.44	84.44	80.00	0.49
12	Lac La Biche		72.09	72.09	69.77	67.44	0.52
2	Footner Lake		88.89	88.89	88.89	86.67	0.25
17	Slave Lake		90.91	90.91	90.91	90.91	0.00
22	Peace River		86.67	86.67	86.67	86.67	0.00
8	Athabasca		95.56	95.56	95.56	91.11	0.49
23	Peace River		86.36	86.36	86.36	84.09	0.25
20	Slave Lake		97.78	97.78	97.78	95.56	0.25
19	Slave Lake		86.67	86.67	86.67	80.00	0.74
46	Bow/Crow		93.33	93.33	93.33	93.33	0.00
32	Edson		83.33	83.33	83.33	80.95	0.26
446	Cypress Hills		95.56	95.56	95.56	95.56	0.00
26	Grande Prairie		86.05	86.05	83.72	81.40	0.52
37	Whitecourt		82.22	82.22	82.22	82.22	0.00
6	Athabasca		97.73	97.73	97.73	95.45	0.25
784	Footner Lake		90.91	90.91	90.91	88.64	0.25
40	Rocky/Clearwater		91.11	91.11	88.89	88.89	0.25
10	Athabasca		88.89	88.89	88.89	88.89	0.00
31	Edson		86.36	86.36	86.36	84.09	0.25
48	Bow/Crow		71.11	71.11	71.11	66.67	0.49
782	Edson		91.11	91.11	86.67	86.67	0.49
783	Bow/Crow		82.22	80.00	80.00	75.56	0.74
Overall mean			88.00	87.92	87.68	85.52	0.28
Standard error			0.92	0.92	0.93	1.00	0.05

† Provenances sorted according to their 21-yr height performance; The abbreviations of traits measured are listed below:

S12 - survival at age 12; S15 - survival at age 15; S18 - survival at age 18;
S21 - survival at age 21; MDS - Mean annual mortality between ages 12 and 21

Table 4. Geographic relationships of white spruce provenances with their 21-year growth (HT21 and DBH21), survival (S21), vigor score (VS21), stem straightness score (SS21) and weevil incidence (WS21) at Chinchaga Genetics Site (G103G).

	HT21	DBH21	S21	VS21	SS21	WS21
Latitude (°N)	0.464*	0.331	0.296	0.550**	0.295	-0.624**
Longitude(°W)	0.035	-0.020	-0.120	-0.020	0.147	0.118
Elevation (m)	-0.629**	-0.531**	-0.269	-0.669**	-0.460*	0.681**

*, ** Significant at 5% and 1% level of probability, respectively; ns indicates non-significant relationship.

4. Range Wide White Spruce Provenance Trial Assessment and Analysis

Seven year assessments and analyses were completed on this trial and reported in 1998. Upon review of the plantation it was decided to postpone further assessment and analysis for a couple of years until further growth and injury has occurred to trees.

5. Manning Area Woodlot Research and Demonstration Project

The research component for this project was designed to include both species and seed source testing in order to identify suitable genetic material for a woodlot program in the Manning area. Experimental design and layout plans were developed and field layout completed. The overall project is being coordinated by the Boreal Wood Centre in Manning. Planting supervision and assistance was provided and an establishment report for the trial was completed.

Approximately 1,080 seedlings for the research trial and 1,040 seedlings for the species demonstration portion of the project were provided by Tree Improvement and Seed Centre (ATISC) . The stock was grown at ATISC greenhouses, sorted, labelled, packed and shipped ready for planting. Assistance was also provided in the experimental design and layout of the Paul Rowe High School white spruce stock handling experiment being supported by MDFP Research Trust Fund. A game fence with hare protection was installed around the woodlot trial by the North Peace Applied Research Association.

6. Progeny Test Site Development and Chinchaga Test Site Maintenance

With the withdrawl of Canfor from the "G2" white spruce project, one progeny test site has been dropped. DRS reservations have been applied for on two of the remaining test sites (Hotchkiss River and Sweeney Creek). A site layout plan was prepared for the Sweeney Creek experimental test site

being developed by the LFS and, based on a 3 ha trial area, perimeter fencing materials for a 6 foot game fence were purchased and delivered to the Hines Creek Ranger Station.

Field maintenance at the Chinchaga site was carried out from June 22- 29, 1998 by ATISC staff. Brushing was completed on the White Spruce Northern Areas Trial (G133B), Region "H"White Spruce Progeny Test (G157B) and Expanded White Spruce Wide Range Provenance Trial (G277A). Trial signs were ordered for the G135A white spruce progeny, G103G white spruce provenance and G133B progeny/provenance trials. These signs will be erected in 1999.

7. Publications

A technical report and a scientific journal article were written from the work completed:

Decosta, T. 1998. Selection of pine parent trees for genetic improvement through breeding; FMU P1D and P2D. Alberta Tree Improvement and Seed Centre, Alberta Environmental Protection. File report ATISC-98-06. 19pp.

Wei, R.P., Hansen, C.R., Dhir, N.K. and Yeh, F.C. 1998. Genetic gain and desired status number in breeding programs: a study of selection effects. Canadian Journal of Forest Research 28:1861-1869.

9. 1998/1999 Expenditures

The budget provided by the Research Trust Fund for 1998/99 ($60,000) was fully spent on project activities by March 31, 1999. The project is being delivered through the Contract and Sponsored Research function of the Alberta Tree Improvement and Seed Cente. In addition to the Trust funding, a considerable amount of additional resources are being invested by Manning Diversified Forest Products Ltd., Daishowa Marubeni International Ltd. and Alberta Land and Forest Service. Additional support is being derived through cooperation with Fairview College and the B.C. Ministry of Forests.

10. Acknowledgment

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